

09/21/00
JC912 U.S. PTO

09-22-00
IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Santosh P Abraham
Mooi Choo Chuah
Kameswara Rao Medapalli
Ashwin Sampath

CASE 3-52-2-6

TITLE ENHANCEMENT OF FRAMING PROTOCOL FRAME FORMAT TO
SUPPORT QUALITY OF SERVICE

ASSISTANT COMMISSIONER FOR PATENTS
BOX APPLICATION
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification – 11 pages
7 Informal Sheets of drawing(s)
1 Assignment(s) with Cover Sheet
Declaration and Power of Attorney
Information Disclosure Statement with 8 references attached.

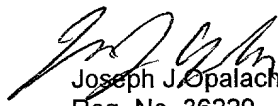
CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	15 - 20 =	0	x \$18 =	\$0
Independent Claims	3 - 3 =	0	x \$78 =	\$0
Multiple Dependent Claims, if applicable			+ \$260 =	\$0
Basic Fee				\$690
			TOTAL FEE	\$690

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of \$690, to cover the filing fee. Duplicate copies of this letter are enclosed. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

The Assistant Commissioner for Patents is hereby authorized to treat any concurrent or future reply, requiring a petition for extension of time under 37 CFR § 1.136 for its timely submission, as incorporating a petition for extension of time for the appropriate length of time if not submitted with the reply.

Please address all correspondence to **Docket Administrator (Room 3C-512), Lucent Technologies Inc., 600 Mountain Avenue, P.O. Box 636, Murray Hill, New Jersey 07974-0636**. However, telephone calls should be made to me at 732-949-1708.

Respectfully,


Joseph J. Opalach
Reg. No. 36229
Attorney for Applicant(s)

Date: September 21, 2000
Lucent Technologies Inc.
600 Mountain Avenue (Room 3C-512)
P.O. Box 636
Murray Hill, New Jersey 07974-0636

"Express Mail" mailing label
number EJ049983211US
Date of Deposit SEPTEMBER 21, 2000
I hereby certify that this APPLICATION is
being deposited with the United States Postal
Service "Express Mail Post Office to
Addressee" service under 37 CFR 1.10 on the
date indicated above and is addressed to the
Commissioner of Patents and Trademarks
Washington, D.C. 20231
Betty Morgan
(Printed name of person mailing paper of fee)
Betty Morgan
(Signature of person mailing paper of fee)

JC913 U.S. PTO
09/666809
09/21/00

ENHANCEMENT OF FRAMING PROTOCOL FRAME FORMAT TO SUPPORT QUALITY OF SERVICE

FIELD OF THE INVENTION

This invention relates generally to communications and, more particularly, to
5 packet communications systems.

BACKGROUND OF THE INVENTION

The wireless market is continuing to grow, and is now beginning to support a
diverse set of applications (e.g., in addition to cellular telephones, it is now possible to
purchase small hand-held devices such as the Palm VII™, which provide access to the
10 Internet via a wireless connection to a service provider.) As part of the ongoing wireless
development, the 3rd Generation Partnership Project (3GPP) is working on a UMTS
(universal mobile telecommunications system) Terrestrial Radio Access Network
(UTRAN). (3GPP is a standards body comprising the European Telecommunication
Standards Institution (ETSI) and several other international standards bodies. Additional
15 information on 3GPP can be found at: “<http://www.3gpp.org>.”)

Currently, in UTRAN, data transmissions between a “Node B” (NB) (also referred
to herein as a base station) and a radio network controller (RNC)) are defined by
dedicated transport channel (DCH) frame protocol (FP) procedures (referred to in
UTRAN as the *Iub* interface). (As used herein, both the NB and the RNC are also
20 representative of wireless network elements.) In particular, the FP procedures define
uplink (from an NB to an RNC) and downlink (from an RNC to an NB) data frames.
Each data frame (uplink or downlink) comprises a header portion and a payload portion
(also referred to as a protocol data unit (PDU)), and supports multiplexing a number of
DCHs in the payload portion. Each DCH comprises transport blocks (TBs), which are the
25 basic units used to convey data. The size and number of TBs in each DCH of a data frame
is identified by an associated transport format indicator (TFI) in the header portion of the
data frame. It should also be noted that these DCH FP procedures also apply to
communications between RNCs (referred to in UTRAN as the *Iur* interface).

SUMMARY OF THE INVENTION

Notwithstanding the association of a TFI field with each DCH in a UTRAN data frame for specifying, effectively, the size of each DCH in the payload portion of the data frame, we have realized that it is also advantageous to further associate each payload of a data frame with a Quality of Service (QoS). Therefore, and in accordance with the invention, a node of a UTRAN based network formats data into a UTRAN data frame comprising a header portion, a payload portion and a quality of service field associated with the payload portion for transmission to another node of the UTRAN-based network.

In an embodiment of the invention, a wireless network element (e.g., a base station) exchanges information with another wireless network element (e.g., a radio network controller) via data frames (uplink or downlink). Each data frame comprising a header portion and a payload portion, which comprises a QoS field (or QoS indicator).

In another embodiment of the invention, the eight bit spare extension field of a UTRAN data frame (uplink or downlink) is used to convey a four bit payload type indicator and a four bit QoS class indicator.

BRIEF DESCRIPTION OF THE DRAWING

FIGs. 1 and 2 show prior art UTRAN data frames (uplink and downlink);

FIGs. 3 and 4 show illustrative UTRAN data frames (uplink and downlink) in accordance with the principles of the invention;

FIG. 5 shows a portion of a UTRAN based wireless system in accordance with the principles of the invention;

FIG. 6 illustrates a protocol layer of use in accordance with the principles of the invention; and

FIG. 7 shows an illustrative high-level block diagram of a wireless network element for use in accordance with the principles of the invention.

DETAILED DESCRIPTION

The inventive concept is described in the context of a UMTS (universal mobile telecommunications system) Terrestrial Radio Access Network (UTRAN) based wireless network but is not so limited. Other than the inventive concept, the details of a UTRAN

based wireless network are well known and are not described herein (e.g., UTRAN specifications can be found at “<http://www.3gpp.org>”). Further, the inventive concept is implemented using conventional programming techniques, which as such, will not be described herein.

As reference, two prior art UTRAN data frames are shown in FIGs. 1 and 2 (e.g., see Technical Specification (TS) 25.427 V.3.3.0: UTRAN Iub/Iur Interface User Plane Protocol for DCH Data Streams for more information about the fields shown in FIGs. 1 and 2). FIG. 1 shows an illustrative UTRAN uplink data frame 11. The latter comprises a header portion 12 and a payload portion 14. The header portion 12 further comprises a header cyclic redundancy check (CRC) field (7 bits), a frame type (FT) field (1 bit), a connection frame number (CFN) field (8 bits), and at least one transport format indicator (TFI) field (8 bits) associated with a respective DCH conveyed in the payload portion 14. A particular value of each TFI field describes, effectively, the size of the associated DCH, i.e., transport block (TB) length and TB set size. As noted earlier, the payload portion 14 supports multiplexing a number of DCHs. This is illustrated by FIG. 1 by the “first DCH” and the “last DCH” portions of payload 14. (For reference purposes, each DCH portion comprises a number of transport blocks (TBs) as illustrated in FIG. 1 for the first DCH of FIG. 1. It may be necessary to insert padding at the end of each TB, as represented by the P field (which although shown as a single bit in FIG. 1, is any number of bits necessary to make a TB an integer number of octets).) Following the DCHs is a quality estimate field (QE) (8 bits), a group of CRC indicator (CRCI) bits (there is one CRCI bit for each TB), a spare extension field (8 bits) and, optionally, a payload checksum field (16 bits).

In a similar fashion, FIG. 2 shows an illustrative UTRAN downlink data frame 21. The latter comprises a header portion 22 and a payload portion 24. The header portion 22 further comprises a header cyclic redundancy check (CRC) field (7 bits), a frame type (FT) field (1 bit), a connection frame number (CFN) field (8 bits), and at least one transport format indicator (TFI) field (8 bits) associated with a respective DCH conveyed in the payload portion 24. Like downlink frame 11, the payload portion 24 supports multiplexing a number of DCHs. Following the DCHs is a spare extension field (8 bits) and, optionally, a payload checksum field (16 bits).

Notwithstanding the association of a TFI field with each DCH in a UTRAN data frame for specifying, effectively, the size of each DCH in the payload portion of the data frame, we have realized that it is also advantageous to further associate each payload of a data frame with a Quality of Service (QoS). Therefore, and in accordance with the invention, a node of a UTRAN based network formats data into a UTRAN data frame comprising a header portion and a payload portion, which comprises a quality of service field associated with the payload portion for transmission to another node of the UTRAN-based network.

Illustrative uplink and downlink UTRAN data frames modified in accordance with the principles of the invention are shown in FIGs. 3 and 4 for use over either the *Iub* or the *Iur* interface. Other than the inventive concept, the structure of these uplink and downlink UTRAN data frames is similar to the data frames shown in FIGs. 1 and 2, and, as such, this structure will not be described again. FIG. 3 illustrates a UTRAN uplink data frame 401 comprising a header portion 412 and a payload portion 414. The payload portion includes, in accordance with the invention, a payload type indicator (PTI) field (4 bits) and a QoS field (4 bits). Thus, a value of each PTI field represents the type of payload and a value of the QoS field indicates a type of QoS to be provided by wireless network elements for that payload. Turning now to FIG. 4, this figure illustrates a UTRAN downlink data frame 501 comprising a header portion 512 and a payload portion 514. Similar to uplink payload portion 414, the payload portion 514 includes a payload type indicator (PTI) field (4 bits) and a QoS field (4 bits). Thus, a value of each PTI field represents the type of payload and a value of the QoS field indicates a type of QoS to be provided by wireless network elements for that payload.

A portion of a UTRAN based wireless system in accordance with the principles of the invention is shown in FIG. 5. Other than the inventive concept, the elements and interfaces shown in FIG. 5 are well-known and will not be described in detail (e.g., see Technical Specification (TS) 25.401 V.3.3.0: UTRAN Overall Description for more information). UTRAN 200 is coupled to a core network (CN) 290 via an *Iu* interface. (It should be noted that the core network may be split into separate domains, e.g., a circuit switched core network and a packet switched core network. In this case, there is one *Iu*

interface for each domain. The core network represents, e.g., other servers and gateways for providing access to the public switched telephone network and/or packet networks (like the Internet.) UTRAN 200 is also coupled to user equipment (UE) (e.g., a wireless mobile endpoint like a telephone and/or computer), as represented by UE 295, via interface *Uu*. UTRAN 200 comprises, e.g., a number of radio network subsystems (RNS) as represented by RNS 205 and RNS 250, which are coupled together via an *Iur* interface. Each RNS comprises at least one radio network controller (RNC), and at least one Node B (NB). A Node B (as noted above also referred to as a base station) is coupled to an RNC through an *Iub* interface and is coupled to a UE through a *Uu* interface. For each connection between user equipment and the UTRAN, one RNS is the Serving RNS (here, illustratively, RNS 205, which communicates via *Iu* 201 with CN 290). Another RNS could be what is referred to as a Drift RNS (here, illustratively, RNS 250, which, if necessary, communicates via *Iu* 202 with CN 290). In accordance with the inventive concept, communications over the *Iub* interface and/or the *Iur* interface utilize an modified FP PDU as illustrated in FIG. 3 for uplink communications and FIG. 4 for downlink communications wherein at least a QoS field is associated with each payload type. (It should be observed from FIGs. 3 and 4 that although considered part of the payload portion of the data frame, the QoS field could instead be included in another part of the data frame, e.g., the header portion.) It should also be noted that the inclusion of a QoS field in an FP PDU facilitates scheduling at not only the *Iub* interface, but also the *Iur* interface.

Illustratively, the QoS field is four bits wide. However, not all of the sixteen possible values need be defined. For example, UMTS allows definition of four QoS classes: conversational, streaming, interactive and background. With respect to the payload type indicator field (also illustratively defined herein as four bits wide), this field is useful to associate different payload types with a particular QoS. As such, an RNS can now utilize QoS information for multiplexing those dedicated transport channels having the same QoS into the same FP PDU.

Turning now to FIG. 6, it should be observed than an FP PDUs can be multiplexed within an IP (Internet protocol) packet. In particular, this figure illustrates an AAL2/IP

(Internet Protocol) multiplexing sublayer of a UTRAN wireless system. (An ATM Adaptation Layer (AAL) maps the services offered by a network to the services required by the application. There are a number of industry standards and proposed standards covering various AALs. In particular, “B-ISDN ATM Adaptation Layer Type 2 Specification,” draft Recommendation I.363.2, November 1996, of ITU-T (herein referred to as AAL2).) As such, an IP multiplexing sublayer can decide whether or not to multiplex the FP PDUs within an IP packet and decide also on the IP Diffserv CodePoints to carry the encapsulated FP PDUs. (Information on Expedited Forwarding (EF) Service, Assured Forwarding (AF) Service, differential service codepoints can be found in, e.g., “An Architecture for Differentiated Services,” RFC2475, December 1998 by S. Blake, et al.; “An Expedited Forwarding PHB”, draft-ietf-diffserv-phb-ef-01.txt, Nov 1998, by V. Jacobson, et al., and “Assured Forwarding PHB Group”, draft-ietf-diffserv-af-03.txt, Dec 1998, by J. Heinanen, et al.) For example, an FP QoS class can be set to a value of 0 to indicate “conversational,” a value of 1 to indicate “Streaming audio,” a value of 2 to indicate “streaming video,” a value of 3 to indicate “interactive,” and a value of 4 to indicate “Background.” Then, the IP multiplexing sublayer can decide to mark the PTI field of the encapsulated FP PDU packet (which is an IP packet) with an EF code point if it is conversational class, or with an appropriate AF codepoint if it is interactive class etc. Alternatively, the FP QoS can be set to class 0 to be raw voice, class 1 to be compressed RTP/UDP/IP packets carrying voice, class 2 to streaming audio, class 3 to streaming video, class 4-6 for interactive, class 7 to background etc. Then, the appropriate multiplexed header is used for raw voice, compressed RTP/UDP/IP packets that carry conversational voice, streaming audio or streaming video.

Turning briefly to FIG. 7, a high-level block diagram of a representative wireless network element 605 for use in accordance with the principles of the invention is shown. Wireless network element 605 is a stored-program-control based processor architecture and includes processor 650, memory 660 (for storing program instructions and data, e.g., for forming the above-described data frames illustrated in FIGs. 3 and 4, etc.) and communications interface(s) 665 for coupling to one or more packet communication paths as represented by path 666 (e.g., 665 represents a transmitter and a receiver). In the

The foregoing merely illustrates the principles of the invention and it will thus be appreciated that those skilled in the art will be able to devise numerous alternative arrangements which, although not explicitly described herein, embody the principles of the invention and are within its spirit and scope. For example, although illustrated in the context of a UTRAN-based wireless system, the inventive concept is applicable to any system (e.g., wired, etc.) that addresses QoS.

WHAT IS CLAIMED:

1 1. A method for use in a node of a UMTS (universal mobile telecommunications
2 system) Terrestrial Radio Access Network (UTRAN) based network for exchanging data
3 with another node of the UTRAN based network, the method comprising the steps of:
4 formatting data into a UTRAN data frame, the UTRAN data frame comprising a
5 header portion, a payload portion for conveying the data and a quality of service (QoS)
6 field associated with the payload portion; and
7 transmitting the UTRAN data frame to the other node.

1 2. The method of claim 1 wherein the payload portion comprises a number of
2 dedicated channels (DCHs) and the QoS field, each dedicated channel comprising a
3 number of transport blocks (TBs), and wherein the header portion comprises a number of
4 transport format indicators (TFI) fields each associated with one of the number of DCHs,
5 each TFI indicating a size of one of the number of DCHs.

1 3. The method of claim 2 wherein the payload portion further comprises a payload
2 type indicator field.

1 4. The method of claim 1 wherein the QoS field is transmitted within the payload
2 portion.

1 5. The method of claim 1 wherein the UTRAN data frame further comprises a
2 payload type indicator field.

1 6. A method for use in a wireless network element, the method comprising the
2 steps of:

3 formatting data into a data frame, the data frame comprising a header portion, a
4 payload portion and a quality of service (QoS) field associated with the payload portion;
5 and
6 transmitting the data frame to another node of the wireless network.

1 7. The method of claim 6 wherein the payload portion comprises a number of

2 dedicated channels (DCHs) and the QoS field, each dedicated channel comprising a
3 number of transport blocks (TBs), and wherein the header portion comprises a number of
4 transport format indicators (TFI) fields each associated with one of the number of DCHs,
5 each TFI indicating a size of one of the number of DCHs.

1 8. The method of claim 7 wherein the payload portion further comprises a payload
2 type indicator field.

1 9. The method of claim 6 wherein the QoS field is transmitted within the payload
2 portion.

1 10. A transmission frame representing data embodied in a wireless transmission
2 signal, the transmission frame comprising:

3 a payload portion comprising at least one dedicated transport channel (DCH)
4 portion, wherein the at least one DCH portion further comprises a number of transport
5 blocks (TB) for conveying data; and

6 a header comprising at least one transport format indicator (TFI) field for the at
7 least one DCH portion, wherein a value of the TFI field represents a size of the at least
8 one DCH; and

9 a quality of service (QoS) field associated with the payload portion.

1 11. The transmission frame of claim 10 wherein the QoS field is transmitted within
2 the payload portion.

1 12. The transmission frame of claim 10 wherein the payload portion further
2 comprises a payload type indicator field.

1 13. Apparatus for use in a wireless network element, the apparatus comprising:

2 a formatter for forming a data frame, the data frame comprising a payload portion
3 comprising at least one dedicated transport channel (DCH) portion, wherein the at least
4 one DCH portion further comprises a number of transport blocks (TB) for conveying data,
5 and a header portion comprising at least one transport format indicator (TFI) field for the
6 at least one DCH portion, wherein a value of the TFI field represents a size of the at least

7 one DCH; and a quality of service (QoS) field associated with the payload portion; and
8 a radio frequency transmitter for transmitting the data frame to another wireless
9 network element.

1 14. The data frame of claim 13 wherein the QoS field is transmitted within the
2 payload portion.

1 15. The transmission frame of claim 13 wherein the payload portion further
2 comprises a payload type indicator field.

ABSTRACT

In a UMTS (universal mobile telecommunications system) Terrestrial Radio Access Network (UTRAN) based wireless system, a wireless network element (e.g., a base station) exchanges information with another wireless network element (e.g., a radio network controller) via data frames (uplink or downlink). Each data frame comprising a header portion and a payload portion, which comprises a QoS class indicator field. Illustratively, the eight bit spare extension field of a UTRAN data frame (uplink or downlink) is used to convey a four bit payload type indicator and a four bit QoS class indicator.

FIG. 2 Abraham-Chuah-Medapalli-Sampath 3-52-2-6

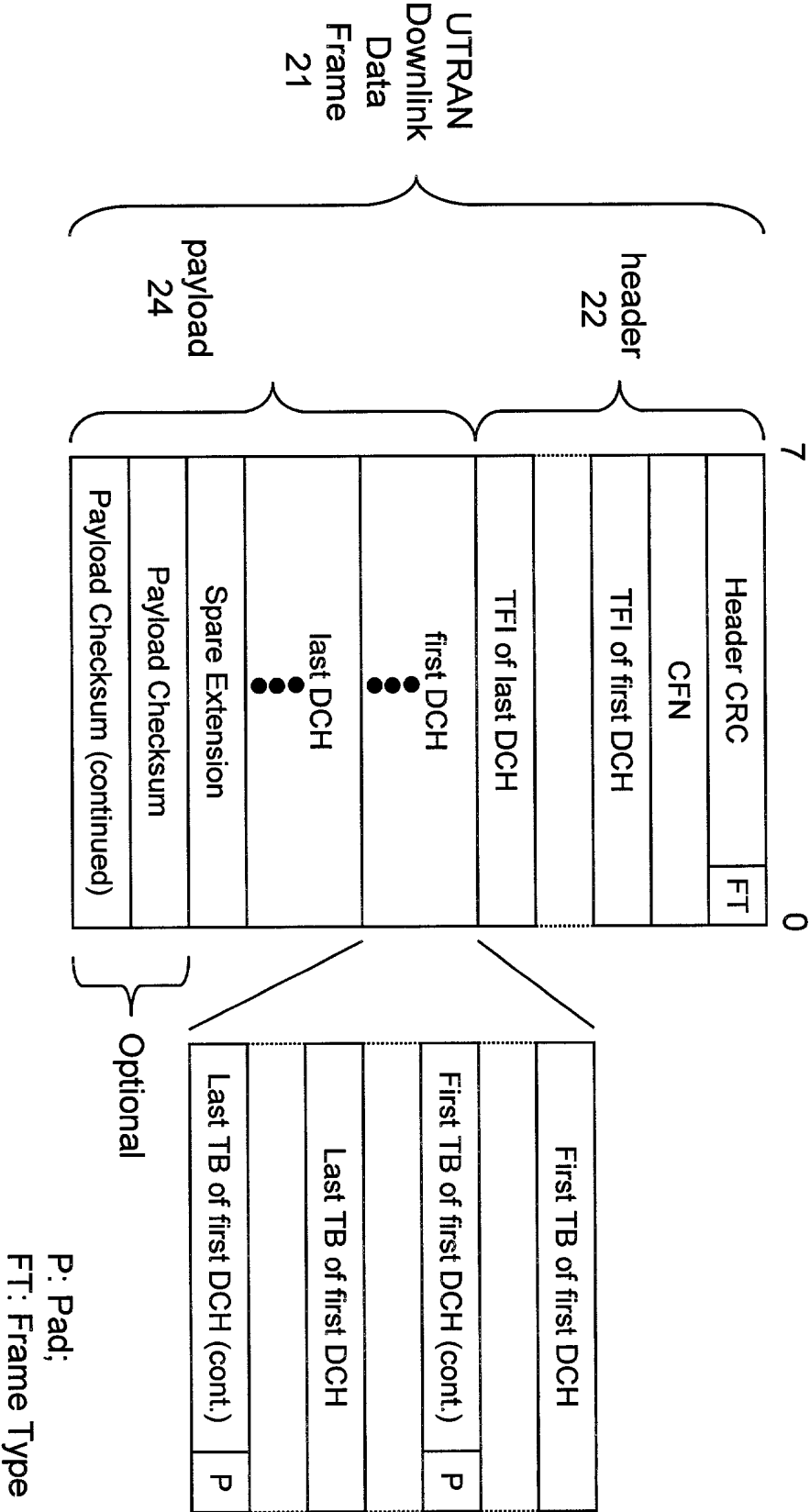


FIG. 3 Abraham-Chuah-Medapalli-Sampath 3-52-2-6

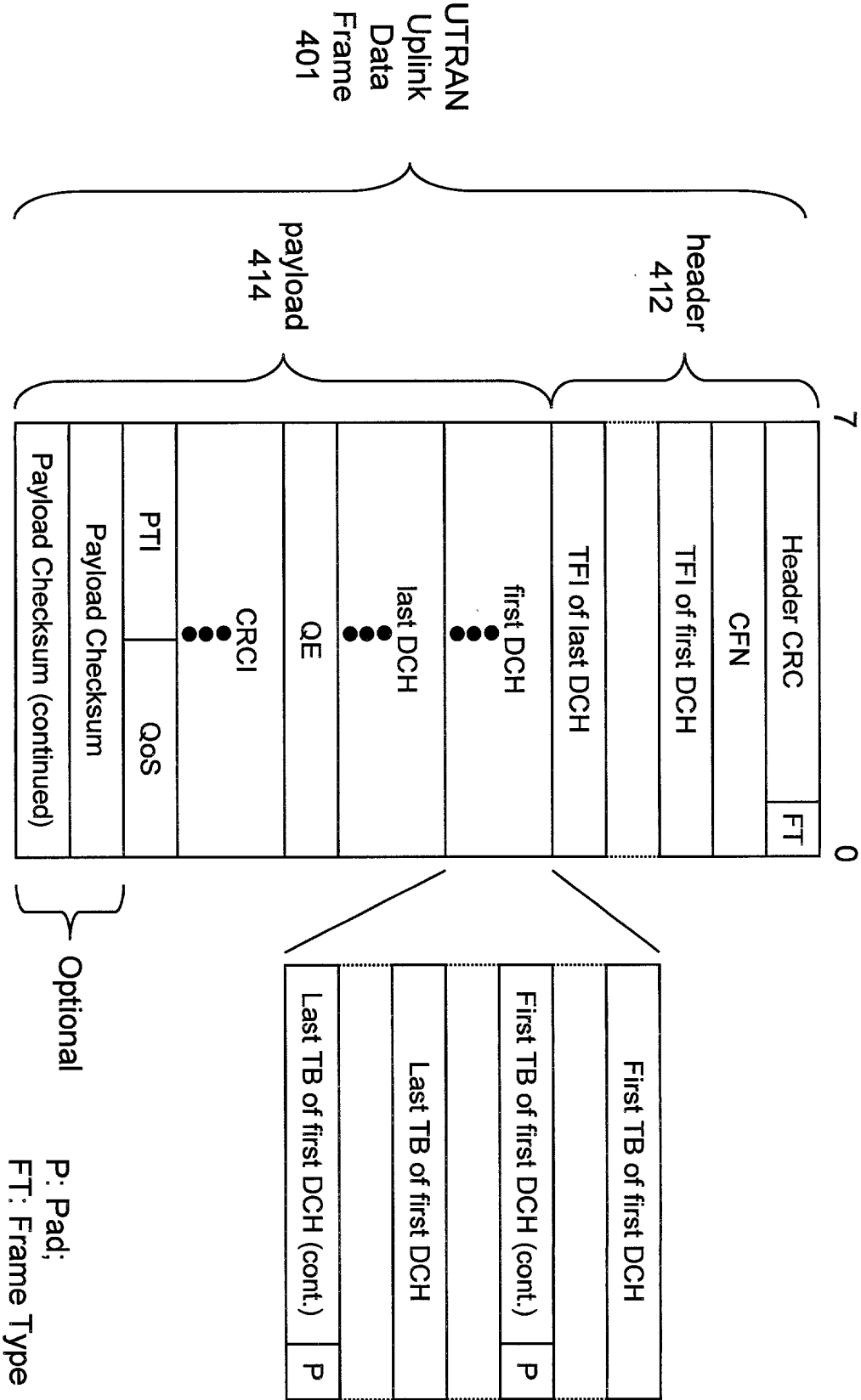


FIG. 4 Abraham-Chuah-Medapalli-Sampath 3-52-2-6

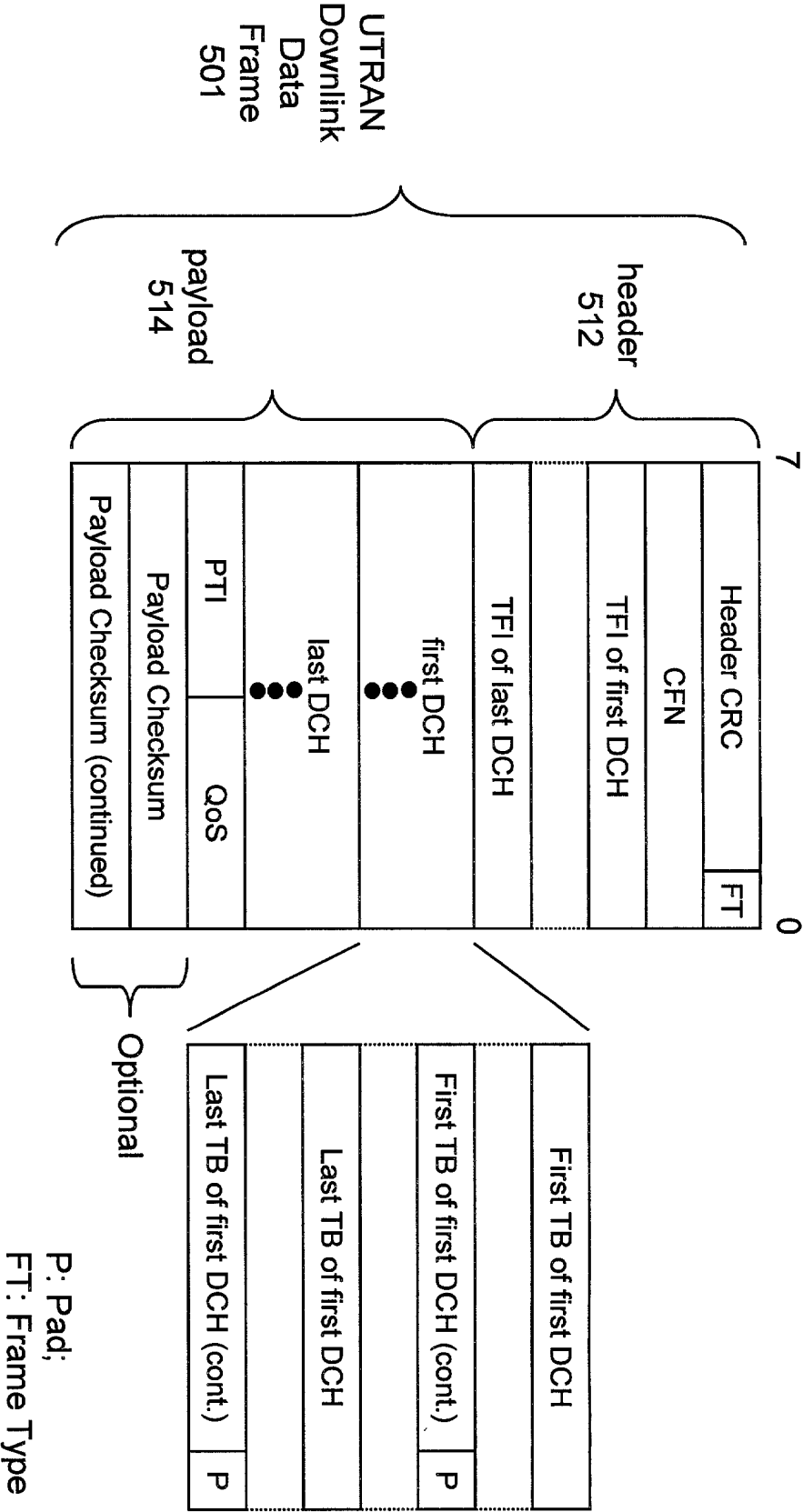
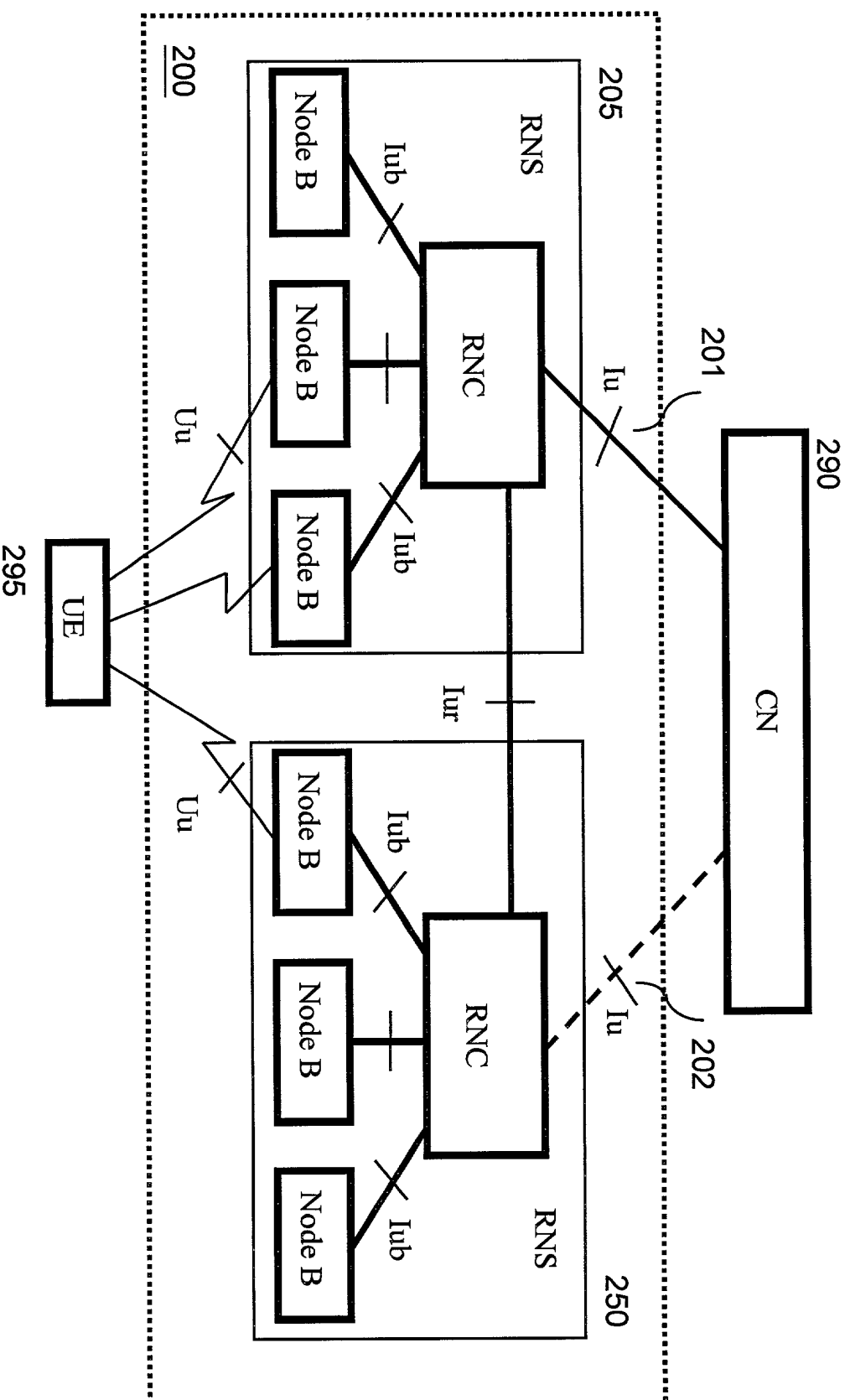


FIG. 5 Abraham-Chuah-Medapalli-Sampath 3-52-2-6



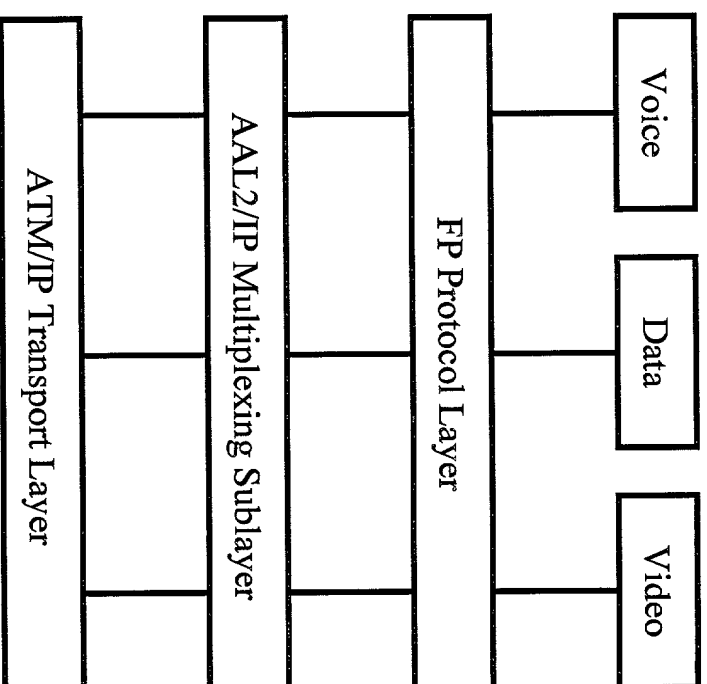
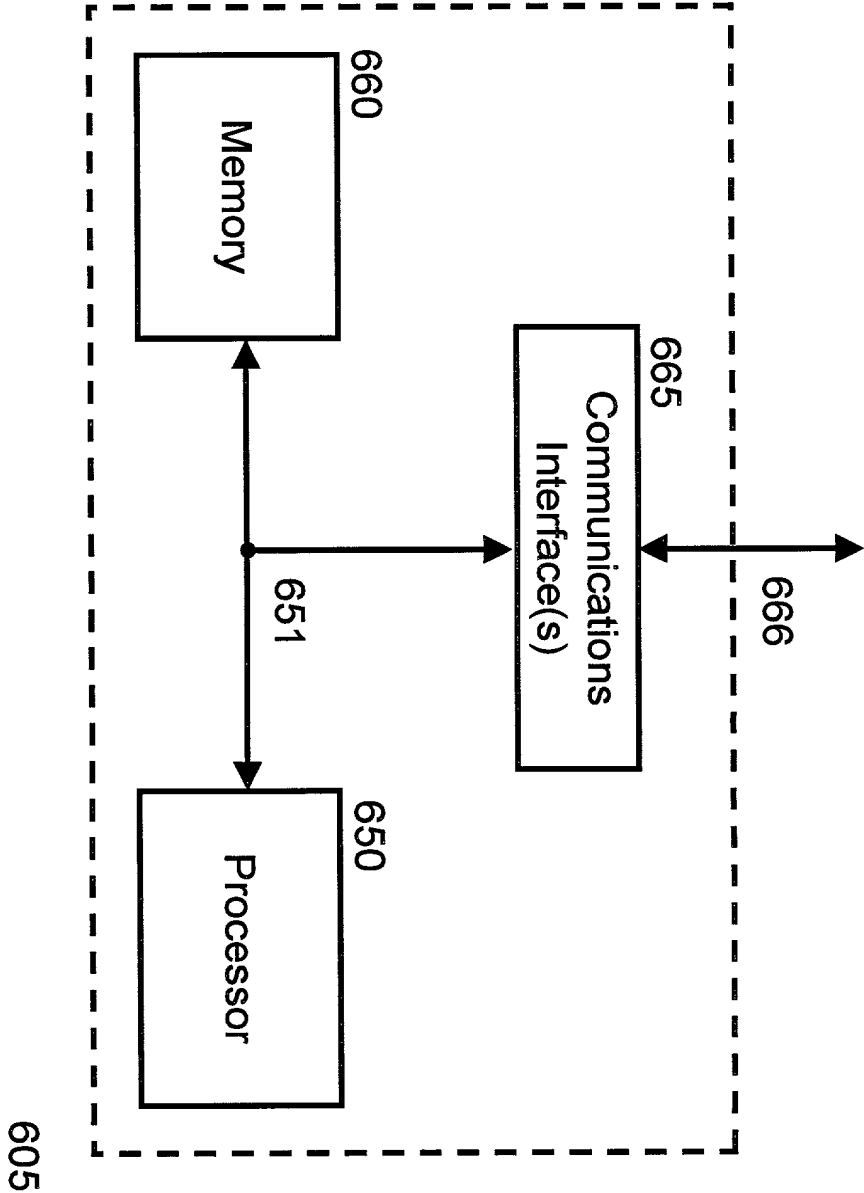


FIG. 6 Abraham-Chuah-Medapalli-Sampath 3-52-2-6

FIG. 7 Abraham-Chuah-Medapalli-Sampath 3-52-2-6



IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **ENHANCEMENT OF FRAMING PROTOCOL FRAME FORMAT TO SUPPORT QUALITY OF SERVICE** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

Thomas J. Bean	(Reg. No. 44528)
Lester H. Birnbaum	(Reg. No. 25830)
Richard J. Botos	(Reg. No. 32016)
Jeffery J. Brosemer	(Reg. No. 36096)
Kenneth M. Brown	(Reg. No. 37590)
Donald P. Dinella	(Reg. No. 39961)
Martin I. Finston	(Reg. No. 31613)
William S. Francos	(Reg. No. 38456)
Barry H. Freedman	(Reg. No. 26166)
Julio A. Garceran	(Reg. No. 37138)
Jimmy Goo	(Reg. No. 36528)
Anthony Grillo	(Reg. No. 36535)
Stephen M. Gurey	(Reg. No. 27336)
John M. Harman	(Reg. No. 38173)
Matthew J. Hodulik	(Reg. No. 36164)
Michael B. Johannesen	(Reg. No. 35557)
Mark A. Kurisko	(Reg. No. 38944)
Irena Lager	(Reg. No. 39260)
John B. MacIntyre	(Reg. No. 41170)
Christopher N. Malvone	(Reg. No. 34866)
John F. McCabe	(Reg. No. 42854)
Scott W. McLellan	(Reg. No. 30776)
Martin G. Meder	(Reg. No. 34674)
John C. Moran	(Reg. No. 30782)
Michael A. Morra	(Reg. No. 28975)
Gregory J. Murgia	(Reg. No. 41209)
Claude R. Narcisse	(Reg. No. 38979)
Joseph J. Opalach	(Reg. No. 36229)
Neil R. Ormos	(Reg. No. 35309)
Jack R. Penrod	(Reg. No. 31864)
Gregory C. Ranieri	(Reg. No. 29695)
Scott J. Rittman	(Reg. No. 39010)
Ferdinand M. Romano	(Reg. No. 32752)
Eugene J. Rosenthal	(Reg. No. 36658)
Bruce S. Schneider	(Reg. No. 27949)
Ronald D. Slusky	(Reg. No. 26585)
David L. Smith	(Reg. No. 30592)
Ozer M. N. Teitelbaum	(Reg. No. 36698)
John P. Veschi	(Reg. No. 39058)
David Volejnicek	(Reg. No. 29355)
Charles L. Warren	(Reg. No. 27407)
Eli Weiss	(Reg. No. 17765)

Please address all correspondence to the Docket Administrator (Rm. 3C-512), Lucent Technologies Inc., 600 Mountain Avenue, P. O. Box 636, Murray Hill, New Jersey 07974-0636. Telephone calls should be made to Joseph J Opalach by dialing 732-949-1708.

Full name of 1st joint inventor: Santosh P Abraham

Inventor's signature Tam Lin Date 9-21-2000

Residence: Keasbey, Middlesex County, New Jersey

Citizenship: Indian

Post Office Address: 208 Sunnyview Oval
Keasbey, New Jersey, 08832

Full name of 2nd inventor: Mooi Choo Chuah

Inventor's signature



Date

9/21/00

Residence: Marlboro, Monmouth County, New Jersey

Citizenship: Malaysia

Post Office Address: 1 Skylark Ct.
Marlboro, New Jersey, 07746

U.S. Patent and Trademark Office

Full name of 3rd inventor: Kameswara Rao Medapalli

Inventor's signature

Date

21st Sep '00

Residence: ~~Ocean~~, Monmouth County, New Jersey

Citizenship: India

Post Office Address: ~~9 Willow Drive, Apartment 8~~
~~Ocean, New Jersey, 07712~~

701 Knollwood Dr,
Middletown, NJ 07748

Inventor's signature Ashwin Date 09/21/2000

Citizenship: India

Post Office Address: 32 Nottingham Way
Somerset, New Jersey, 08873